UMAB PoLSMER

Online https://www.asjp.cerist.dz/en/PresentationRevue/871
ISSN: 2800-101X, **E-ISSN**: 2992-0949
Volume 2, Number 2, July 2024

RESEARCH ARTICLE

Study of biodiversity in some citrus orchards in the agricultural basin of Tlemcen (Northwestern Algeria)

Chemouri Somia [1,2,3♠], Ainad Tabet Mustapha [1], Belmir Meriem [1]

[1] Faculty of Sciences of Nature and Life, Earth, and Universe Sciences, Abou Bekr Belkaid University, Tlemcen, 13 000, Algeria
[2] Higher School of Agronomy Mostaganem, Mostaganem, 27 000, Algeria. [3] Laboratory of Biodiversity and Conservation of Water and Soil, Abdelhamid Ibn Badis University, Mostaganem, 27 000, Algeria.

(♠ s.chemouri@esa-mosta.dz)

Received: March 30, 2024/ **Accepted:** June, 30, 2024/ **Published:** July 15, 2024

ABSTRACT

The study approach was designed to analyze beforehand the floristic composition of the weed flora of some citrus orchards in the agricultural basin of Tlemcen and draw up an exhaustive inventory to show the difference between the floristic composition of the weeds at the row level compared to the inter-row of citrus orchards, based on aCorrespondence Factor Analysis (CFA)of the flora readings. The floristic inventory consisted of 85 species, belonging to 35 botanical families, and 71 genera. The best-represented families were Asteraceae (12.94%), Poaceae (12.94%), and Fabaceae (9.41%). This flora was dominated by dicotyledonous, Mediterranean taxa, and therophytes as the most represented biological spectrum, thus confirming a tendency to therophytization. The CFA revealed the existence of a significant difference between the floristic composition of weeds in row and inter-row in citrus orchards with the recognized species *Melia azedarach* L. and *Convolvulus althaeoides* L. as bio-indicators of this distinction which were only present in the rows of the studied citrus orchards.

Keywords: Weeds, floristic composition, biodiversity, citrus orchards, Tlemcen

INTRODUCTION

The cultivated lands are characterized by a flora, often referred to as “weeds”, in English, “mauvaises herbes” or “adventices’, in French. Weeds are herbaceous or woody plants that grow in unwanted places. Weeds are often considered the biggest obstacle to agricultural production because they are adapted to the same soil and climate conditions as crops. Therefore, practices that promote crop cultivation also promote the growth of weeds.

The concept of biodiversity is associated with weeds in cultivated lands. Citrus orchards are irrigated crops offering very favorable conditions for weeds to thrive. The diversity and richness of the floristic composition of the citrus weed flora captivated the attention of many researchers, representing a good example of the study of plant diversity (Mashaly and Awad, 2003, Le Bellec, 2015, Gomaa, 2017). Not only but also, because the identification of weeds is a primordial step before adopting any weeding management strategy (Nirmaljit and Rattanpal, 2017). Moreover, many studies have been undertaken to study the citrus weed flora, focusing on its floristic composition (Mashaly and Awad, 2003, Chafic et al., 2013, Gomaa, 2017), diversity(Kiran Kumar and Kiran Babu, 2019), ecology and characterization of weed communities (Le Bellec, 2015, Serag et al., 2015, Hannachi, 2019) and its evolutionary changes (Protopapadakis, 1985). Along with the different weeding strategies and soil management in relation to its biodiversity (Antunes et al., 2005, Mas and Verdú, 2005, Shweta et al., 2018). In citrus orchards, competition between weeds and young trees occurs mainly for limited resources (nutrients, water, light, and space). In addition, weeds harbor insects and rodents that attack citrus trees (kazi Tani, 2010, Nasr et al. 2013). In the literature, different weeding methods were discussed, mechanical, chemical, mulching, and covering crops (Sharma and Singh, 2006, Verdú and Mas, 2007, Jannoyer, 2011, Emre Kitiş et al., 2017). Inside the same citrus orchard, the composition and distribution of the weed flora is affected by several factors: climatic variables, altitude, soil properties and the weeding methods (Onen, 2018, Al-Qahtani, 2019, Chemouri et al., 2019).

The objective of this study was to analyze the floristic composition of the citrus weed flora and to show whether there is a difference between the floristic composition of weeds located in rows and those in the inter-rows based on a statistical analysis of the floristic readings arried out in these different locations, in the rows and inter-rows.

MATERIALS AND METHODS

Study area

The study of the citrus weed flora in the agricultural basin of Tlemcen (Northwest of Algeria) was based on the execution of floristic inventories. A total of sixteen citrus orchards, located in four regions, Sidi Abdeli, Bensekrane, El Fhoul, and Ain Youcef were selected (Figure 1). The four regions are located on the interior plains of Tlemcen,mainly formed by flat geomorphological structures, which oscillate between 200 and 400meters above sea level. The terraces of these plains have fertile soil and are intended for agricultural purposes. Oued Tafna and Oued Isser drain this sector. The basin of Tlemcen is dominated by a Mediterranean, semi-arid climate with a moderate winter. A semi-continental influence with a seasonal pattern of precipitation of the HPAE type [Winter (H), Spring (P), Autumn (A), and Summer(E) marks this region. Citrus growing is an irrigated crop and is mainly concentrated around the irrigated perimeters of Tafna, Isser, and Sekkak.

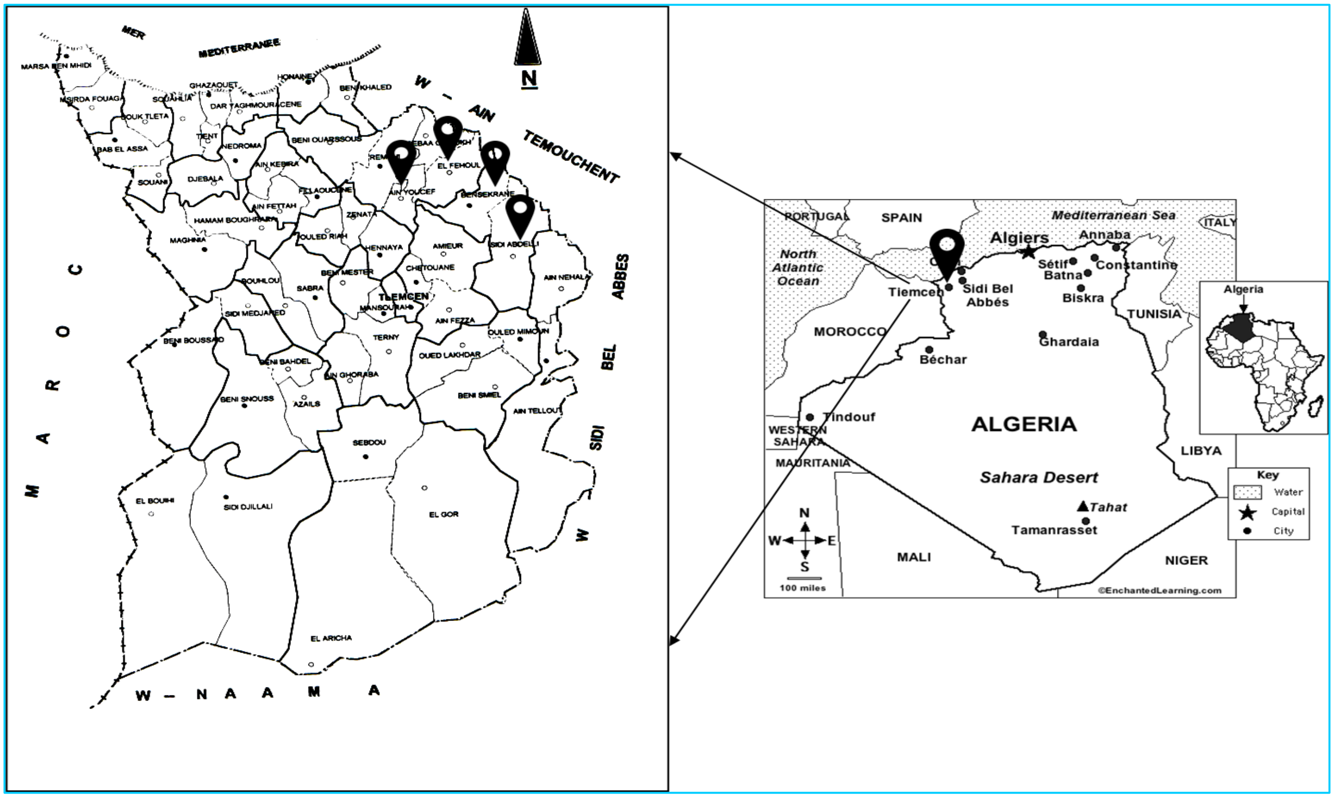

Figure 1. Location of the studied regions in the agricultural basin of Tlemcen (Northwest of Algeria).

Floristic data

The citrus orchard was considered a homogeneous operating unit (same technical itinerary) and a homo-ecological zone (one management unit). Sixty-four flora readings were taken, from March to May 2014, asstated by the method of Braun-Blanquet (1951) and Guinochet (1973). The minimal area was 30 m^2 as recommended by Sorenson (1948) for studying perennial crops.The floristic readings achievedwere located inside each of the citrus orchards so that two readingswere taken at the level of the rows and two others on the inter-row.A presence-absence index was assigned to each species found.

Floristic and statistical analyses

To study the citrus orchard's biodiversity, two complementary approaches were used, an approach relating to the characterization of floristic diversity through the identification of the taxonomic families of the species inventoried, their biological types, biogeographic distribution,and their modes of seed dispersal.

For the identification and the biogeographical distributionof the inventoried species, thenew flora of Algeria and southern desert regions (Quézel and Santa, 1962-1963) was utilized.The biological spectrum was determined according to the biological classification of plants proposed by Raunkiaer (1905, 1934). In addition, the perturbation index (IP) was calculated to quantify the therophytization of the studied environment, as calculated by Loisel et *al.* (1993). The formula mentioned below was used:

IP (%) = [(Number of Chamaephytes + Number of Therophytes) / Total number of species]

The second approach was statistical,based on realizing a Correspondence Factor Analysis (CFA), using the software Minitab 16 to determine whether there is a difference between the floristic composition of weeds in rows and those in the inter-rows. To facilitate data processing, a number was assigned to each survey and a three-letter code was assigned to each species inventoried.

The first two letters indicate the genus; the last letter indicates the first letter of the adjective of the genus, for example, *Avena sterilis* L. (Avs).

RESULTS AND DISCUSSIONS

Floristic composition

The floristic analysis aimed to characterize the richness of the weed flora of citrus orchards from a taxonomic and biological point of view. From the 64 floristic readings conducted, 85 weed species were inventoried, which were all angiosperms, belonging to 35 botanical families, and 71 genera (Table 1). With a rate of 81.18% (69 species), dicotyledonous contributed to the citrus weed flora. In contrast, 18.82% (16 species) represented the contribution of monocotyledonous. Similar findings for the dominance of dicotyledonous in the citrus weed flora have been previously reported (Chafik et al., 2013, Nasr et al., 2013, Shweta et al., 2018). In addition, Kazi Tani et al. (2010) also highlighted their dominance in the weed flora of the Oranian phytogeographic territory (Northwest Algeria).

The best-represented families were Asteraceae (12.94%), Poaceae (12.94%), and Fabaceae (9.41%)(Table 1). These same botanical families have been reported as dominant in the Oranian phytogeographic sector (Kazi Tani et al., 2010), with a slightly different ranking (Asteraceae, Fabaceae, Poaceae, representing together 39%). Our findings are in concordance with some research already conducted on citrus weed flora, reporting the dominance of Poaceae and Asteraceae with very close rates (Mashaly and Awad, 2003, Nasr et al., 2013, Cristaudo et al., 2015). Moreover, Asteraceae, Poaceae, and Fabaceae are the three botanical families repeatedly mentioned in the literature as most represented in citrus weed flora (Bensellam, 1997, Chafic et al., 2013, Onen et al., 2017, Gomaa, 2017).

On the other hand, the weeds botanical families with low presence rates of around 1% were defined by some families, e.g., Aristolochiaceae, Cucurbitaceae, Labiaceae, etc. (Table 1). The species representing Oleaceae (*Olea europea* L.), Palmaceae (*Chamaerops humilis* L.), Ulmaceae, (*Celtis australis* L.), Araliaceae (*Hedera helix* L.), Meliaceae (*Melia azedarach* L.), Rhamnaceae (*Ziziphus lotus* (L.) Desf.) are either phanerophytes or nanophanerophytes which is an accidental case to find inside a citrus orchard. The introduction of these species is probably due to ornithochory which is the principal mode of dispersal of species with fleshy fruits. These species are recognized by the fact that they are all apophytes of orchards and vineyards (Kazi Tani, 2010, Chemouri and Belmir, 2013).

Table1. Total botanical families contribution.

Botanical families	Genera	Number of species	Contribution (%)
Asteraceae	11	11	12.94
Poaceae	8	11	12.94
Fabaceae	7	8	9.41
Apiaceae	4	5	5.88
Solanaceae	3	3	3.53
Rosaceae	3	3	3.53
Convolvulaceae	1	3	3.53
Malvaceae	1	3	3.53
Araceae	2	2	2.35
Brassicaceae	2	2	2.35
Papaveraceae	2	2	2.35
Boraginaceae	2	2	2.35
Euphorbiaceae	2	2	2.35
Polygonaceae	2	2	2.35
Amarantaceae	1	2	2.35
Chenopodiaceae	1	2	2.35
Geraniaceae	1	2	2.35
Liliaceae	1	2	2.35
Fumariaceae	1	2	2.35
Araliaceae, Aristolochiaceae, Cucurbitaceae, Meliaceae, Oleaceae, Labiateae, Caryophylaceae, Oxalidaceae, Rhamnaceae, Palmaceae, Portulacaceae, Primulaceae, Rubiaceae, Scrophulariceae, Ulmaceae, and Urticaceae.	1 for each	1 for each	1.18for each

Biological spectrum

Figure 2 presents the biological spectrum established for the inventoried weeds inside the citrus orchards, which was of the type: Th.>He.>G.> Ch.>Ph.>Nph. Therophytes (Th.) dominated over the other biological types capitalizing alone more than half (Th., 58.82%), followed by hemicryptophytes (He., 16.47%) and geophytes (G., 11.76%). Chamaephytes (Ch., 5.88%), phanerophytes (Ph., 4.71%) and nanophanerophytes (Nph., 2.35%) were in the last positions (Figure 2). Chafic et al. (2013) and Kazi Tani et al. (2010) reported the dominance of Th. Furthermore, recent studies also showed their abundance (Cristaudo et al., 2015, Onen et al., 2017, Gomaa, 2017, Chemouri et al., 2019). In a separate case, the abundance of perennial and biennial weeds over annuals was registered by Nasr et al. (2013), which may be due to the difference in weed management strategies which favors perennials and biennials which adapt to a certain stability of the soil.In cultivated fields, the wide distribution of Th. could be directly related to the high level of artificiality caused by human influencebut it could be also attributed to the characteristics of the climate, the topographic variation, and other biotic parameters.

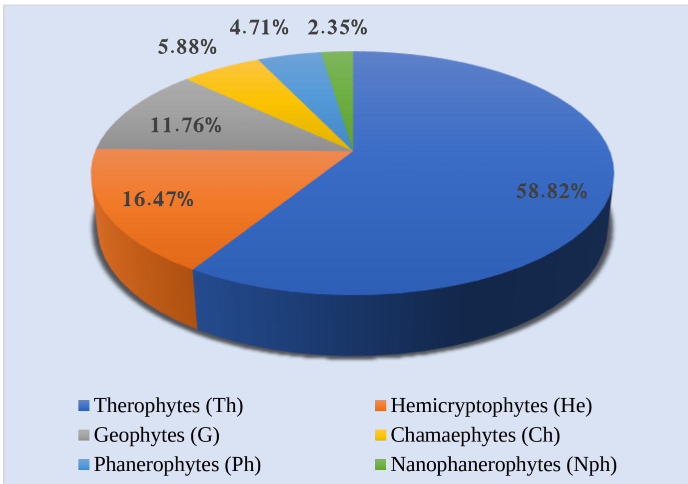

Figure 2. Biological spectrum of the inventoried weed species.

Perturbation index (IP)

For the studied orchards, the calculated index was around 65%, which confirmed that the growing environment in the citrus orchards is well protected by the farmer and that this index from this point of view is not perturbation but conservation.

The biological types are an expression of how plants and flora can adapt to their surroundings. The tendency toward therophytization, is clear, allowing researchers to confirm that certain ecological environments can only exist as they do because the stations under study have an agricultural vocation that necessitates ongoing human intervention to enhance the cultivated agricultural product (Raunkiaer, 1905, Quézel, 2000).

Biogeographic distribution

Results depicted in Table 2 showed that the Mediterranean elements sensu lato dominated the weed flora (63.56%). This contribution was slightly higher than that (57.64 %) announced by Kazi Tani et al. (2010) and slightly lower than that (66.77%) obtained by Chafik et al. (2013). However, the dominance of Mediterranean elements in citrus orchards has been reported previously by several scientists (Bensellam, 1997, Mashaly and Awad, 2003). The studied region is part of the Mediterranean basin which can clearly explain the abundance of Mediterranean taxa.

Dissemination of weed seeds

According to the mode of dissemination of weed seed (Figure 3), zoochores dominated the weed flora with a rate of 41.17%, followed by clitochore at a high rate (36.47%) as well. Anemochore (14.12%) and myrmecochore (8.24%) were the following ranks (Figure 3).Zoochores have also been reported as very frequent in the Oranian phytogeographic sector by Kazi Tani et al. (2010).The low number of anemochores at the studied citrus orchards was due to the initial low rate of Th. since this is the regular mode of dissemination of this biological type. From an evolutionary point of view, the dispersal strategies adopted by weeds are a form of adaptation to temporal variations and environmental conditions.

Table 2. Biogeographic distribution of inventoriedweed species.

Geographic distribution	Number of species	Contribution (%)
Mediterranean	21	24.71
Mediterranean-Iranian-Turanian	11	12.94
European-Mediterranean	6	7.06
Eurasian	6	7.06
Paleo-Temperate	5	5.88
European-Siberian-Mediterranean	4	4.71
European-Siberian Mediterranean-Iranian-Turanian	4	4.71
Cosmopolitan	3	3.53
Sub-cosmopolitan	2	2.35
Ibero-Mauritanian	2	2.35
Mediterranean-Macaronesian	2	2.35
Circumboreal	2	2.35
North American	2	2.35
Atlantic-Mediterranean	1	1.18
Paleo-Subtropical	1	1.18
Circum- Mediterranean	1	1.18
Mediterranean-Tropical	1	1.18
Western Mediterranean	1	1.18
Thermo cosmopolitan	1	1.18
North Tropical-Temperate	1	1.18
Sub-Mediterranean	1	1.18
Eurasiatic- Macaronesian	1	1.18
Eurasiatic- African	1	1.18
Mediterranean-Sub-Atlantic	1	1.18
North African	1	1.18
South African	1	1.18
European-Siberian	1	1.18
South-east Asiatic	1	1.18

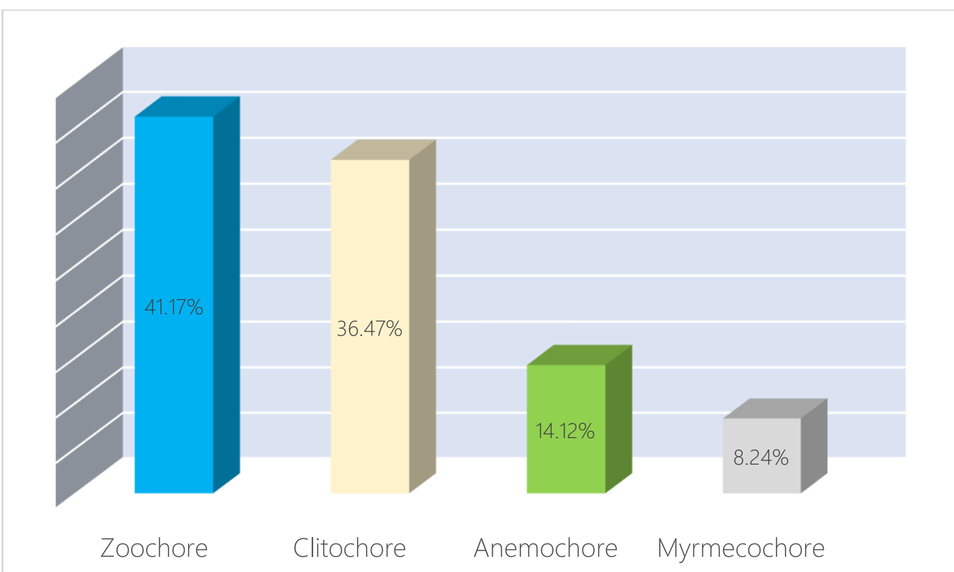

Figure 3. Modes of weed seed dispersal.

Difference between the floristic composition of the row and inter-row

CFA is a statistical processing that applies to vegetation data. It allows a flat graphic representation, expressing the relations of proximity between objects, between variables, and between objects and variables. CFA is a well-known tool allowing a global approach to obtain a synthetic vision on the one hand between species and on the other hand between species and environmental factors. According to Table 3, it is noticeable that the inertia rate of axis 1 exceeds 50% and that the difference between the latter and axis 2 is significantly important. Consequently, the statistical analysis of axis 1 and its ecological significance in the factorial plane was the only one considered.

Table 3. Inertia ratio of axes 1 and 2.

Axes	1	2
Correct values (species and surveys)	0.6957	0.1380

The ecological significance for the floristic readings factorial plane (F1-F2) of Axis 1

As shown in Figure 4 and Table 4, there was an opposition between flora readings located in the inter-row of citrus orchards and those located in the row of this same citrus orchard. Consequently, the criterion of distinction between weed species should be confirmed in the same species factorial plan of the same axis. Table 4 displays the floristic readings with the high contribution for axis 1 on both positive and negative sides. As well as species with high contributions for the same axis and on both sides (positive and negative).

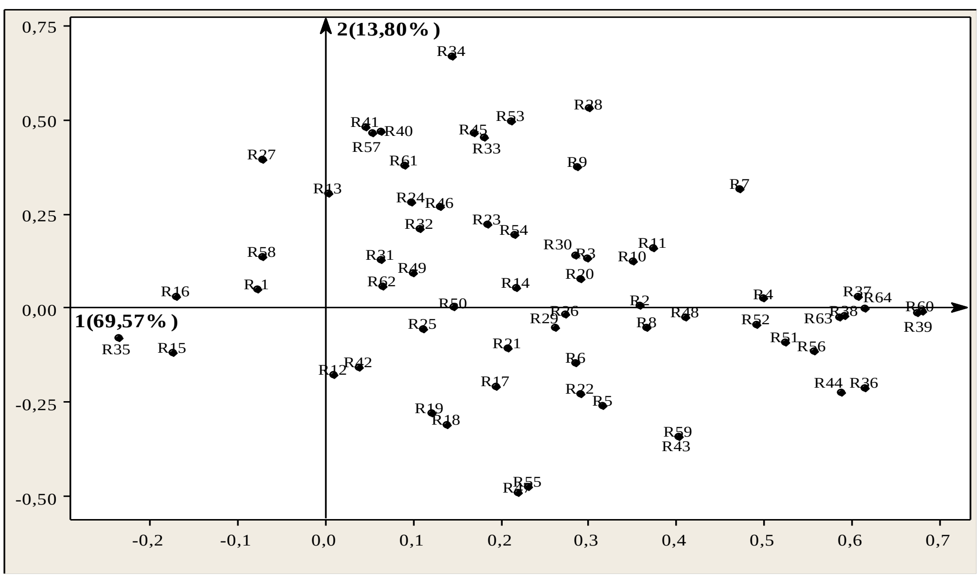

Figure 4. Floristic readings factorial plane (1-2)

Table 4. Floristic readings and species with high contribution for axis 1.

Readings with high contribution for axis 1	
Positive side of axis 1	Negative side of axis 1
Reading 60	Reading 35
Reading 39	Reading 15
Reading 64	Reading 16
Species with high contribution for axis 1	
Positive side of axis 1	Negative side of axis 1
*Sinapis alba*L. (Sia)	*Melia azedarach*L. (Mea)
*Hordeum murinum*L. (Hom)	*Convolvulusalthaeoides*L. (Coa)

The ecological significance for the species factorial plan (F1-F2) of Axis 1

The ecological significance of the species factorial plan is shown inFigure 5.On this axis, an ecological gradient was noticed, ranging from shaded environments, consisting of *Melia azedarach*L. and *Convolvulus althaeoides*L. located in thereadings exclusively in the rows and absent in the inter-rows. Therefore, from an ecological point of view, define the environments, from forest and scrub typeto those open with a thermo-heliophilic character for recognized species of fields and crops such as *Sinapis alba*L. and *Hordeum murinum*L. (Quézel and Santa, 1963) located with a much greater presence frequency in the inter-rows than in the rows. To summarize, the CFA revealed the existence of a significant difference between the floristic composition of weeds in row and inter-row in citrus orchards with the recognized species *Melia azedarach* L. and *Convolvulus althaeoides* L. as bio-indicator of this distinction which were only present in the rows of the studied citrus orchards.

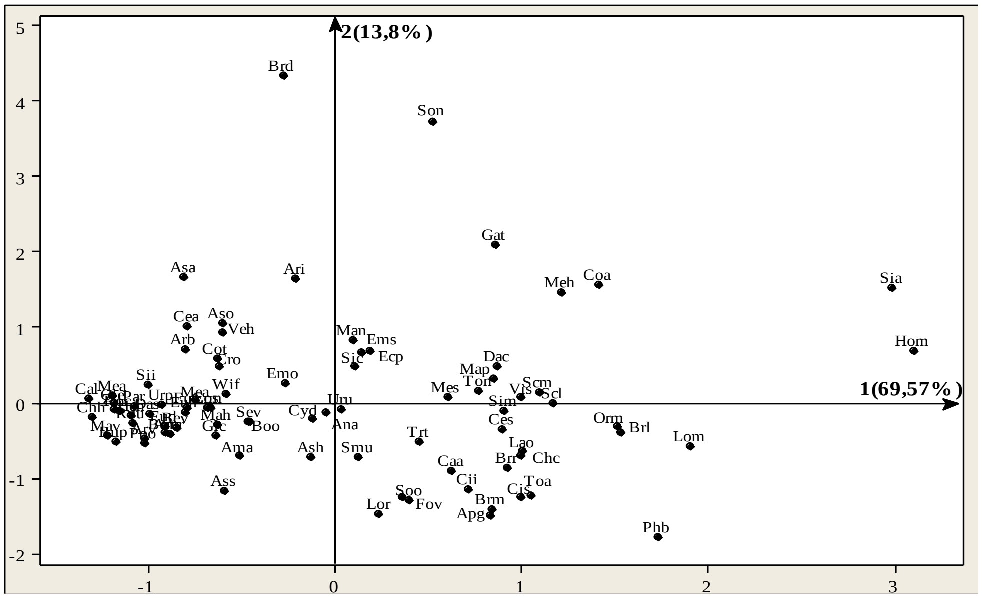

Figure 5. Species factorial plane (1-2)

CONCLUSION

The present study revealed that the studied citrus weed flora was rich and diverse, counting 85 weed species belonging to 35 botanical families, and 71 genera. Asteraceae, Poaceae, and Fabaceae were the most predominant botanical families, and the Mediterranean taxa remained the most representative overall.This flora was dominated by dicotyledonous while the most widespread biological spectrum was represented by therophytes. In addition, the tendency to therophytizationwas confirmed. From an ecological point of view, the high perturbation index of around 65% can be interpreted as an element of soil conservation of any water deficit.

The CFA showed the existence of a significant difference between the floristic composition of weeds in row and inter-row in citrus orchards and that certain species can be exclusively subservient to a particular presence inside a crop field (example of *Melia azedarach* L. and *Convolvulus althaoides* L. in the studied citrus orchards). To extend knowledge on this subject, further studies are recommended for other agricultural perimeters of Mediterranean citrus orchards.

AUTHOR CONTRIBUTIONS

This study was accomplished during a master's thesis for graduating in Agronomic Sciences from Abou Bekr Belkaid University (Tlemcen, Algeria). CS and BM conducted research work at the field level. CS wrote the paper. All the authors reviewed and approved the final version of the manuscript.

COMPETING INTERESTS

The authors have declared that no competing interests exist.

REFERENCES

1. Al-Qahtani, S.M. (2019).Effect of soil properties on the diversity and distribution of weeds in citrus farms in Arid region. *Applied Ecology and Environmental Research*, 17(1), 723-732. https://doi.org/10.15666/aeer/1701_723732
2. Antunes, R., Franco, J.C., Moreira, I., Silva, E.B., Soares, C., Sousa Bastos, M.E., Vasconcelos, M.T. (2005). Flora and weed management in citrus orchards. ActasReunión de la SEMh 2005. Lisbon, Portugal.
3. Bensellam, E. H., Bouhache, M., Taleb, A. (1997).Etude des adventices des vergers d'agrumes dans le Gharb (Maroc) : aspects floristique, agronomique et écologique. *Weed Research*, *37*(4), 201–210. https://doi.org/10.1046/j.1365-3180.1997.d01-34.x
4. Braun-Blanquet, J. (1951).Pflanzensoziologie. Grundzuge der vegetations (Autriche : Vienne Ed.).
5. Chafic, Z., Berrichi, A., Bouali, A., Taleb, A. (2013).Systematic, phytoecological and agronomic survey of citrus fruits weed flora in the North-eastern Morocco. *Moroccan Journal of Biology*. 10, 20-29.
6. Chemouri, S., Ainad Tabet, M., Kechairi, R., Tefiani, C., Megharbi, A., Roca-Fernandez, A. I., Larid, M. (2019). Impact of mechanical and chemical weeding on the floristic diversity of citrus orchards in Tlemcen (Northwestern Algeria). *International Journal of EnvironmentalStudies*. 77(4), 602-612. https://doi.org/10.1080/00207233.2019.1690279
7. Chemouri, S., Belmir, M. (2013). Étude des apophytes au niveau de quelques agrumeraies du basin agricole de Tlemcen (Nord-Ouest algérien). Thes. Ing., Univ. Tlemcen, 88pp.
8. Cristaudo, A., Restuccia, A., Onofri, A., Lo Giudice, V., Gresta, F. (2015).Species–area relationships and minimum area in citrus grove weed communities. *Plant Biosystems*, 149(2), 337-345. https://doi.org/10.1080/11263504.2013.825344
9. Emre Kitiş, Y., Kolören, O., Uygur F.N. (2017). The Effects of Mulch Textile Application on Weed Control and Mandarin Growing in Newly Established Mandarin Orchard. *Turkish Journal of Agriculture - Food Science and Technology*, 5(6), *568-580*.
10. Gomaa, N.H. (2017). Floristic Composition of Weed Vegetation in Citrus Orchards in Aljouf Region, Kingdom of Saudi Arabia. *Journal of Bio-Molecular Sciences (JBMS)*. 5(1), 15-23. https://www.directsciences.com/files/Gomaa.pdf
11. Guinochet, M. (1973). Phytosociologie, Ed. Masson, Paris.
12. Hannachi, A. (2019). Ecological study for groups of citrus weeds in the Skikda region, Algeria. *Journal of Research in Weed Science*, 2, 216-223. https://doi.org/10.26655/jrweedsci
13. Int.J.Curr.Microbiol.App.Sci. 8(04): 2100-2107. https://doi.org/10.20546/ijcmas.2019.804.247
14. Jannoyer, M.L., Le Bellec, F., Lavigne, C., Achard, R., Malézieux, E. (2011).Choosing cover crops to enhance
15. ecological services in orchards: A multiple criteria and systemic approach applied to tropical areas. *ProcediaEnvironmental Sciences*, 9, 104-112. https://doi.org/10.1016/j.proenv.2011.11.017
16. Kazi Tani, C. (2010). Contribution à l'étude des communautés d'adventices des cultures du secteur phytogéographique oranais (Nord-Ouest algérien) : Aspects botanique, agronomique et phyto-écologique. Thes. Doc., Univ. Tlemcen, 226pp.
17. Kazi Tani, C., Le Bourgeois, T., Munoz, F. (2010). Contribution à l'étude des communautés d'adventices des cultures du secteur phytogéographique Oranais (nord-ouest algérien) : Aspects botanique, agronomique et phyto-écologique. Flora Mediterranea, 20, 29-46.
18. Kiran Kumar, K. & Kiran Babu, P. (2019).Diversity of Weed Flora in Citrus at ICAR-Regional Research Centre for Citrus, Biswanath Chariali, Assam, India.
19. Le Bellec, F. (2015). Caractérisation des communautés adventices des vergers d'agrumes de la Réunion et détermination d'espèces favorables à la mise en place de la lutte biologique par conservation. 1-51.
20. Loisel, R., Gamila, H. (1993). Traduction des effets du débroussaillement sur les écosystèmes forestiers et pré-forestiers par un indice de perturbation. Annales de la Société des Sciences Naturel et d'Archéologiede Toulon et du Var 45, 123-132
21. Mas, M.T., Verdú, A.M.C (2005). Biodiversidad de la flora arvense en cultivos de mandarino según el manejo del suelo en las interfilas. *Boletín de sanidad vegetal. Plagas*, 31, 231-241.
22. Mashaly, I.A., Awad, E.R. (2003).Weed flora of orchards in the Nile Delta, Egypt: Floristic Features. *Asian Journal of Plant Sciences*, 2(3), 314-324.
23. Nasr, N., Miyandeh, H.B. (2013). Weeds identification in west of Mazandaran Province citrus orchards (Iran). *American Journal of Research Communication*, 1(6), 27-38.
24. Nirmaljit, K., Rattanpal, H.S. (2017). Weed management in citrus orchards. *Rashtriyakrishi*, 12(1), 122-122.
25. Onen, H., Akdeniz, M., Farooq, S., Hussain, M., Ozaslan, C. (2018). Weed flora of citrus orchards and factors affecting its distribution in western Mediterranean region of Turkey. *Planta Daninha*, 36(54), 1-14. https://doi.org/10.1590/S0100-83582018360100036
26. Protopapadakis, E. (1985). Changement de la flore adventice des vergers d'agrumes en Crète sous la pression du désherbage chimique. Agronomie, *EDP Sciences*, 5(9), 833-840. https://doi.org/10.1051/agro:19850910
27. Quézel, P. (2000). Réflexions sur l'évolution de la flore et de la végétation au Maghreb méditerranée. Ibis. Press. Ed. Paris, 117p.
28. Quézel, P., Santa, S. (1962-1963). Nouvelle Flore de l'Algérie et des Régions Désertiques Méridionales. Éd. C.N.R.S, Paris, Tome 1 (1962), 565 pp, Tome 2 (1963), 571-1170 pp.

29. Raunkiaer, C.C. (1905). Types biologiques pour la géographie botanique. *Kongelige Danske VidenskabernesSelskabsForhandlinger*, 5, 347-438.

30. Raunkiaer, C.C. (1934). The Life Forms of Plants and Statistical Plant Geography; Being the Collected Papers of C Raunkiaer (Oxford: Oxford Univ. Press).

31. Serag, M., Khedr, A., Rabei, S., Elkomy, A. (2015). Ecological Study on Weed Flora Growing in the Orchards of New Damietta. *Journal of Plant Production*, 6(12), 2003–2018. https://doi.org/10.21608/jpp.2015.52128

32. Sharma, S.D., Singh, M. (2006). Gramoxone Inteon- a New Formulation for Weed Management in Citrus. *Proceedings of the Florida State Horticultural Society*, 119, 172-176.

33. Shweta, Rana, G.S., Duhan, A., Kaur, A. (2018).Evaluation of different herbicides on weed control, yield, and quality of sweet orange. *Chemical Science Review and Letters*, 7(26), 528-532.

34. Sorensen, T. (1948). A method of establishing groups of equal amplitude in plant sociology based on similarity of species content. *Det Kongelige Danske VidenskabernesSelskab. BiologiskeSkrifter*, 5(4), 1-34.

35. Verdú, A. M., & Mas, M. T. (2007).Mulching as an alternative technique for weed management in mandarin orchard tree rows. Agronomy for Sustainable Development, 27(4), 367–375. https://doi.org/10.1051/agro:2007028